

d) REMARKS

The claims are 1-5, 8 and 11 with claim 1 being independent. Claims 9 and 56 have been cancelled. Support for the amendments to claim 1 can be found, inter alia, on page 5, line 26 to page 6, line 5; page 6, line 27 to page 7, line 4; page 25, lines 23-25; page 26, lines 15-24 and page 81, lines 1-6.

Claims 1, 3, 5, 8, 11 and 56 were rejected as anticipated by Ikeda '683 based on the disclosure in columns 1 and 8. Claims 2, 4 and 9 and were rejected as obvious over Ikeda, in view of either Pang, Murakami or Kikuchi. Claims 1-5, 8 and 11 were also rejected as obvious over Parry '500 in view of LePetitcorps. In the Examiner's Response to Arguments on page 5, paragraph No. 7 of the outstanding Official Action, the Examiner argues the temperature is by-product specific and it would be obvious to use the temperature of 1,400°C. The Examiner further argues that the claims do not recite generating powdery by-product. The grounds of rejection are respectfully traversed.

Initially, the claims have been amended to address the Examiner's stated concern that a powdery by-product was not recited. The claims now state a powdery by-product is generated and, inter alia, is treated to decompose it. Previously, in a CVD apparatus for formation of a semiconductor thin film or a processing apparatus, such as a deposited film etching apparatus, when a gas containing a silicon compound as a main component (e.g., SiH₄ type gas) was used to conduct processing, a powdery by-product was generated within the apparatus. The generated by-product powder tends to contaminate the deposited film and/or adhere to exhaust pipes or valves to block them. Moreover, the

pressure inside a reaction chamber may be adversely influenced or operational defects in the conductance adjusting valve may be caused.

Under processing conditions at higher deposition rates of deposited film, the generation of powdery by-product becomes quite substantial and interferes with the film, the processing and the exhaust apparatus.

The above-mentioned problems are overcome by the present process in which a filament comprising a high-melting metal selected from tungsten, molybdenum and rhenium is employed and the powdery by-product is heated to a temperature range of 1400°C to 2200°C. Not only the non-reacted gas, but also powdery by-products, are efficiently heated/decomposed and deposited as a hard film on a trap wall surface. Specifically, by employing tungsten, molybdenum or rhenium as the material of the filament, it is possible to maintain filament heat resistance and durability in a reducing atmosphere containing H₂, which tends to make filaments brittle.

The cited references neither disclose nor suggest the problems resulting from generation of powdery by-product, its contamination of a deposited film, its adherence to exhaust pipes or valves resulting in blocking, and the like. Therefore, a skilled artisan, even when considering the cited references, would not understand the unique features of heating a filament of the specified high-melting metal to a temperature of 1400°C to 2200°C to decompose not only a non-reacted gas, but also a by-product, and to perform deposition thereof as a hard film on a trap wall, thus removing them from the exhaust gas.

In the cited prior art processes, the speed of decomposing non-reacted compound gas and depositing the decomposed gas products on a trap wall surface is relatively low. Under such processing conditions where the amount of by-products generated is relatively small, then, even when the filament temperature is as low as 500°C, as in Ikeda, both a non-reacted gas and a by-product can be decomposed and deposited as a hard film on a trap wall surface. In Ikeda, a range of 150°C-500°C is disclosed.

However, under more rigorous processing conditions yielding a high deposition rate of deposited film, the increased amounts of by-products cannot be decomposed efficiently at a filament temperature on the order of 500°C. Thus, there is a need for a technique to efficiently decompose both significant quantities of non-reacted gas and by-product under stringent film-forming conditions.

Unexpectedly, the present inventors have found that by heating a high-melting filament to an elevated temperature of 1400°C to 2200°, both non-reacted gas and by-product can be efficiently decomposed and deposited as a hard film on a trap wall surface.

At the lower limit (1400°C) of the instant claimed temperature range, not only non-reacted gas, but also powdery by-product, can efficiently be decomposed. The upper limit of the claimed temperature range (2200°C) is just below the melting point of the material of the claimed filament. However, if the filament temperature is raised further, there is a possibility that the vacuum seal of the processing apparatus may be influenced (i.e., degraded or broken).

None of the cited references teach or suggest the problem of treating by-products formed under severe production conditions. The references fail to teach generation of powdery by-product, forming a deposited film of the by-product, adherence of the powdery by-product to exhaust pipes or valves which result in blocking, or the like.

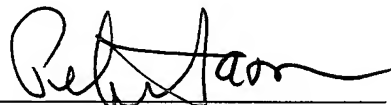
As shown in Table 2 on specification page 137 and as discussed in Example 2 on pages 81-82, enhanced results are achieved at a filament temperature of at least about 1400°C (page 82, line 27 to page 83, line 1). The double circle in the Table shows that in 100 cycles no film deposition occurred on the filament and no defects were measured on the conductive adjusting valve.

As seen in Tables 2 and 3 on pages 137 and 138, when the filament temperature was as high as about 2200°C excellent results were obtained. When the filament temperature was significantly above about 2200°C, film deposition rate on the trap declined and the vacuum seal portion around the trap required cooling. The melting point of the claimed filaments is from 2620°C to 3410°C. As the filament temperature approaches these melting points even more severe problems occur.

Wherefore, none of the references disclose or suggest the claimed invention nor render it unpatentable. The amendment should be entered, the final rejection withdrawn, the claims allowed and the case passed to issue.

Applicants' undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Peter Saxon", written over a horizontal line.

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